

# Efficiency of Lime Sulfur in the Control of Two-Spotted Mite in Papaya in Conventional and Organic (Bokashi-EM) System

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**Abstract:** Lime sulfur was tested to control two-spotted mite (*Tetranychus urticae*) evaluating the injury and number of alive or dead mites in leaves 4 and 25 days after spraying in the organic and conventional systems. Lime sulfur did not cause injury in plants. On the 4<sup>th</sup> day in organic system the average number of mites were 35.4 percent alive and 64.6 percent dead in Formosa cultivar and 20.5 percent alive and 79.5 percent dead in Hawaii. In conventional system the average was 18.2 percent alive and 81.8 percent dead in Formosa and 17.3 percent alive and 82.7 percent dead in Hawaii. The evaluation of mite number 25 days after application in Formosa showed 1.28 alive in organic and 7.46 in conventional. In Hawaii cultivar the average was 3.48 for organic and 10.74 for conventional. During these 25 days, plants of organic system, received one spray of EM and the conventional five sprays of miticide, two of fungicide and one leaf fertilizer. The number of mites alive 25 days after spraying showed lime sulfur residual and physiological effect in plants. In both cultivars the organic (Bokashi-EM) system demonstrated superiority over conventional. The organic mite control was more profitable and ecologically superior to the conventional eliminating the use of pesticides.

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**Introduction** Lime sulfur by its properties as fungicide, bactericide, miticide, insecticide and source of sulfur and calcium is efficient in the winter treatment of fruit trees and in the whole vegetative cycle of various crops. Its action against agents that cause powdery mildew, apples scab, brown rot, pink disease, late bright and controlling pests and mites of leprose, orange rust, two-spotted and mealybugs justify its use (Zamberlan & Fronchetti 1994). When compared with pesticide presents a cheaper control and best of all is not harmful to humans and environment. The well known action of lime sulfur as source of calcium, sulfur and control of diseases and pests in citrus, coffee, peach, apple and vegetables in general, is guaranteed as an alternative and ecological defensive.

The research objectives were: a) evaluate the lime sulfur efficacy to control two-spotted mite (*Tetranychus urticae*) in conventional and organic (Bokashi-EM) system; b) determine the lime sulfur phytotoxicity and c) control of flowers and fruits dropping in papaya.

## Materials and Methods

The experiment was installed in San Diego Farm, Conceicao da Barra, State of Espirito Santo. It was set using papaya Formosa and Hawaii cultivars, in initial flowering stage, cultivated in two systems, conventional (Martin et al. 1995) and organic with Bokashi-EM, under irrigation.

Lime sulfur 30° B was sprayed with cyclone in both cultivars at concentration of 1.0 percent using 2,000 liters in 1.1 ha and at concentration of 1.25 percent applied with

a back pack spray (20 liters) in cropping area of conventional and organic system (Zamberlan and Fronchetti 1994).

The mite evaluations were done 4 and 25 days after its application and counting made on the last but one oldest green leaf, areas with injury symptom, using magnifying lens (12 x) area of 1cm<sup>2</sup> (Martin et al. 1995). The number of plants and leaf areas varied on the 25<sup>th</sup> day's evaluation. A completely randomized sampling was used within the two cropping systems and cultivars. The sampling area was extended to include a conventional surrounding field to better represent the level of attack on the crop. Different levels of mite attack were observed between rows near and far from the spraying machine. Therefore plants were separated in rows near and far from sprayer to measure the effect of products deposition in mite control. The details of sampling in the two cultivars and systems are shown in Tables 1 and 2.

To control pests and diseases the pesticides used by growers in conventional and surrounding areas were a) two-spotted mite (*Tetranychus urticae*); abamectin (Vertimec) + tetradifon (Tedion), clofentezine (Acaristop and fermpropathrin (Danimen) + tetradifon; b) disease black spot (*Asperisporium caricae*): benomyl (Benlate) and methyl thiophanate + chlorothalonil (Cerconil); c) caterpillar (*Erinnyis ello*): deltamethrin = pyrethrin (Decis) + fenitrothion = pyrethrins (sumidon). Besides these products plants received applications of aminoacids (Aminon) and macro and micronutrient (Green-top) as leaf fertilizer (Martin et al. 1995). For statistical analysis non parametric test of Wilcoxon and Kruskal-Wallis, and significance of ( $p \leq 0.05$ ) were used SAS (1989).

**Results  
and  
Discussion**

During evaluations any phytotoxic effect of lime sulfur was not observed in all concentrations and experiments. The efficiency varied with concentrations and period of application. The results of Table 1 show in cultivar Formosa sprayed with lime sulfur at 1.0 percent, the efficiency of control was 64.6 percent, while Hawaii had efficiency of 79.5 percent. The lime sulfur at concentration of 1.25 percent (Table 1) demonstrated equivalent control of mite in Formosa and Hawaii cultivars with efficiency of 81.82 percent and 82.72 percent respectively.

**Table 1. Control of Two-Spotted Mite in Formosa and Hawaii Papaya Cultivated in Organic (Bokashi-EM) System, with Irrigation**

Total and Averages	Number of Plants	Cultivars			
		Formosa		Hawaii	
		Total of mites		Total of mites	
		Alive	Dead	Alive	Dead
<b>Conventional</b>					
Total	42	16	72	14	67
Average	3	0.38	1.71	0.33	1.59
%		18.18	81.82	17.28	82.72
<b>Organic</b>					
Total	48	97	177	40	155
Average	4.8	2.02	3.69	0.83	3.23
%		35.4	64.6	20.51	79.49

Evaluation = 1 cm<sup>2</sup>/plant 4 days after spraying with lime sulfur 30° B at 1.0 % or 1.25 %  
 Samples place = penultimate basal leaf and area with injury symptoms  
 Counting of mite = in the colony with magnifying lens (12 x), 4 days after spraying

During the period of 25 days after lime sulfur application the parcels of organic systems received only one spray of EM and the conventional system: five applications of miticide, two of fungicide and one leaf fertilizer. According to Table 2 in the second evaluation the Wilcoxon and Kruskal-Wallis test ( $p \leq 0.0001$ ) showed significant differences between organic and conventional treatments and between plants in rows near and far from sprayer only in the conventional system. In organic system the number of mites was similar in rows near and far from sprayers. The number of mites was statistically different ( $p \leq 0.0001$ ) in both cultivars, the averages were respectively 2.18 and 8.87 on organic and conventional indicating increase of 407 percent in the conventional system. These data show that the agrochemical (5 applications of miticide, 2 of fungicide and one of leaf fertilizer) used in the conventional system increased the susceptibility of the plants to two-spotted mite.

Counting the mites in rows near and far from sprayer (Table 2) showed uneven deposition of product in leaves near and far away from the sprayer, demonstrating clearly that the spraying equipments are very inefficient. This inefficiency alters the control of mites, diseases and pests by protective pesticides. Because the lime sulfur acts in the physiology of the plant the effects of bad deposition do not affect the efficiency of control (Huber 1980 Chaboussou 1987).

**Table 2. Effect of Lime Sulfur in the Control of Two-spotted Mite 25 Days after Spraying Papaya cvs Formosa and Hawaii Cultivated in Conventional and Organic System**

Number Total	Organic		Conventional	
	Row Distance from Sprayer			
	Near	Far	Near	Far
Plant evaluated	53	53	95	95
Mites	88	144	679	1006
General average	1.66a	2.71a	7.15a	10.59b
Average of mites	2.18 A		8.87 B	

**Conclusion** From the experimental conditions we can conclude that:

- The average control of mites of 82.27 percent was considered efficient in both cultivars and cropping systems.
- The organic system with Bokashi-EM can use lime sulfur to control two-spotted mite with superior results than conventional products.
- The response to lime sulfur was associated with correction of calcium deficiency indicating that lime sulfur action is connected to nutritional and physiological changes in plant according to the theory of trophobiose.
- In conventional system the pesticide and spraying equipments are inefficient causing frequent re-infestations and increase plant susceptibility to mites.

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